PRELIMINARY

INSTRUCTION MANUAL

FOR

REGULATED POWER SUPPLIES

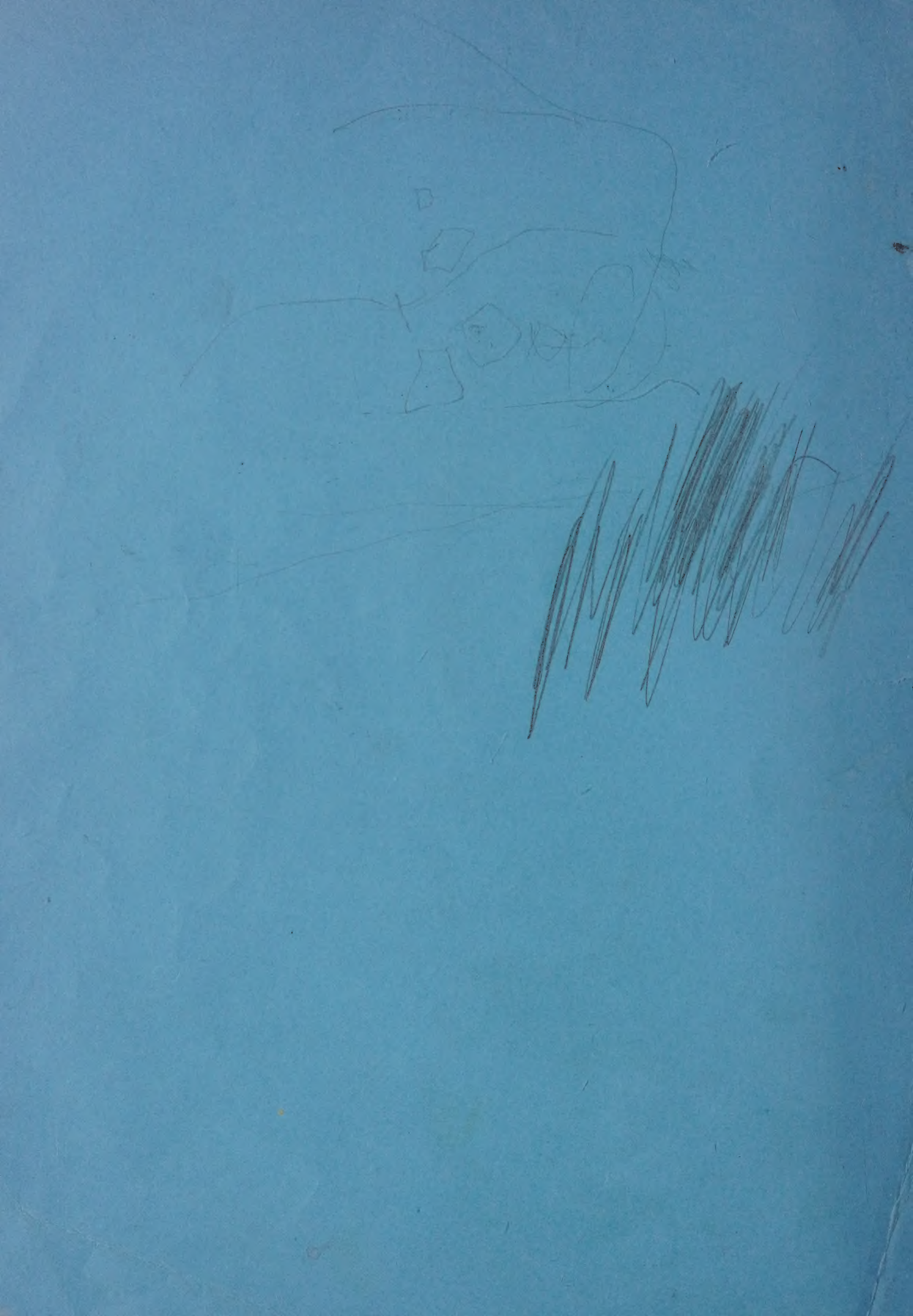
MODEL LE 104

MODEL LE 104M

MODEL LE 104FM

MP MASTER
MA28341

LAMBDA ELECTRONICS CORP. MELVILLE, L. I., NEW YORK



PRELIMINARY

INSTRUCTION MANUAL

FOR

REGULATED POWER SUPPLIES

MODEL LE 104

MODEL LE 104-M

MODEL LE 104-FM

This manual provides instructions intended for the operation of Lambda power supplies, and is not to be reproduced without the written consent of Lambda Electronics Corp. All information contained herein applies to both metered and non-metered models unless otherwise specified.

SPECIFICATIONS AND FEATURES

Specifications apply for the non-metered LE 104 and metered LE 104-M and LE 104-FM* models.

* For FM suffixed models specifications apply to rear output terminals only.

DC OUTPUT--Voltage regulated for line and load

Voltage Range	0-36 volts DC
Current Range	0-25 amperes, for entire voltage range

REGULATED VOLTAGE OUTPUT

Regulation (line)	Less than 0.05 percent or 8 millivolts, whichever is greater, for input variations from 105-135 or 135-105 volts AC
Regulation (load)	Less than 0.05 percent or 8 millivolts, whichever is greater, for load variations from 0 to full load or full load to 0
Transient Response (line)	Output voltage is constant within regulation specifications for any 15-volt line voltage change within 105-135 volts AC
Transient Response (load)	Output voltage is constant within 25 millivolts for load changes from 0 to full load or full load to 0, within 50 microseconds after application
Remote Programming Constant	50 ohms/volt output, constant over entire regulated voltage range
Internal Impedance	Less than 0.8 milliohm
Ripple and Noise	Less than 0.5 millivolts rms with either positive or negative terminal grounded
Temperature Coefficient	Output change in voltage less than 0.015%/°C

DC OUTPUT--Current regulated for line and load

Current Range	2.5-25 amperes
Voltage Range	0-36 volts DC, for entire current range

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REGULATED CURRENT OUTPUT

Regulation (line)...Less than 0.2 percent or 14 milliamperes, whichever is greater, for input variations from 105-135 or 135-105 volts AC

Regulation (load)...Less than 0.2 percent or 15 milliamperes, whichever is greater, for load voltage changes from 0 to 36 or 36 to 0 volts DC

Ripple and Noise....Less than 10 milliamperes rms with either positive or negative terminal grounded

Remote Programming..500-ohm 4-watt resistor adjustable over entire regulated current range

AC INPUT--105-135 volts AC at either 45-66 cps* or 320-480 cps*; 1590 watts**

* Use the frequency selector switch to use power supply at either input-power frequency band

** With output loaded to full rating and input voltage 135 volts AC

OVERLOAD PROTECTION

Thermal.....Thermostat, reset by power switch; thermal overload indicator, front panel

Electrical

External.....Adjustable, automatic, electronic current-limiting circuit, settable from 10 percent to 110 percent of load; limits output current to preset limit for protection of load and power supply when external overloads and direct shorts occur

Internal.....Fuses provide protection against internal circuit failure

INPUT AND OUTPUT CONNECTIONS--Heavy duty terminal block on rear of chassis with 8-foot, 3-wire detachable line cord for all models; three, five-way binding posts provide for additional positive (+) ground and negative (-) DC output connections on front panel of FM models

NOTE: For applications requiring load currents exceeding 15 amps DC remove line cord plug assembly, and connect three #10 AWG standard wires to the barrier strip color coded and connected as follows:

Black (Hot Lead).....Terminal 1
White (Common).....Terminal 2
Green (Ground).....Terminal 5-Chassis

OPERATING AMBIENT TEMPERATURE AND DUTY CYCLE--Continuous duty at full load from 0°C to +50°C (122°F) ambient

STORAGE TEMPERATURE- -55°C to +85°C
(non-operating)

METERS-Ruggedized voltmeter and ammeter on metered models

CONTROLS

DC output Controls.....	Coarse and fine voltage controls and current control adjust and limit DC output; located on front panel of FM models and on rear of all models
Remote Sensing.....	Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation
Operating Mode Monitor.....	Load fault indicator illuminates when load conditions cause departure from selected mode of operation

PHYSICAL DATA

Mounting.....	Standard 19" rack mounting
Size.....	10 1/2"H x 19"W x 16 1/2"D
Weight.....	150 lbs. net; 200 lbs. shipping wt.
Panel Finish.....	Grey ripple enamel (standard); special finishes available to customer's specifications at moderate surcharge.

OPERATING INSTRUCTIONS

CONTROLS, INSTRUMENTS AND FUSES

POWER ON Switch. The POWER ON switch, located on the front panel, controls application of input power to the supply and resets the thermostat after thermal overload occurs. When the switch is in the ON position, the green POWER ON indicator glows. When THERMAL OVERLOAD indicator lights, place POWER ON switch in off (down) position to reset thermostat.

VOLTAGE CONTROLS V and ΔV. Voltage Control V, a coarse adjustment potentiometer, varies the DC voltage over a range of 0-35 volts and control ΔV, the fine adjustment potentiometer, varies the DC voltage over a one-volt range. Clockwise rotation results in increasing voltage. The total DC voltage output, for voltage regulated operation, is equal to the sum of V and ΔV setting; for current regulated operation the maximum voltage limit is equal to the sum of V and ΔV setting. Both controls are located on the rear deck of all units as well as on the front panel of all FM suffixed units. On the FM units, use only the front panel controls.

CURRENT CONTROL-CURRENT LIMITER Control. This potentiometer varies the DC current over a range of 2.5-27.5 amperes and, for current or voltage regulated operation, limits the DC current output to the setting on the control. Clockwise rotation results in increasing current. This control is located on the rear deck of all models as well as on the front panel of FM suffixed models. On FM models only use the front panel current control.

INPUT FREQ SWITCH. The INPUT FREQ SWITCH, with toggle locking plate, located on the rear deck of all models, permits selection of power supply operation from either of two input frequency bands; 45-66 cps or 320-480 cps. Loosen two screws to release the toggle locking plate and place toggle in desired frequency band position; tighten the screws to secure the toggle in position.

INDICATOR SELECTOR Switch and LOAD FAULT ON Indicator. The INDICATOR SELECTOR switch permits the selection of either CURRENT REGULATED or VOLTAGE REGULATED mode of operation to be monitored by the LOAD FAULT ON indicator. When monitoring either mode of operation, the LOAD FAULT ON indicator will illuminate to indicate that load conditions have exceeded the preset limits for the selected mode of operation and the unit no longer is functioning in the selected operating mode. Both indicator and switch are front-panel mounted on all models.

Thermostat and THERMAL OVERLOAD Indicator. The thermostat, located inside the rear deck, opens when the temperature of the supply exceeds a maximum safe value. Opening of the thermostat causes the red THERMAL OVERLOAD indicator to turn (front panel) to glow. Place POWER ON switch in off (down) position to reset thermostat and to allow the supply to cool. When proper temperature is reached, place POWER ON switch to the ON position to restore normal operation.

OUTPUT VOLTAGE Meter. A 0-36 volt DC voltmeter monitors the voltage at the output terminals of metered units.

OUTPUT CURRENT Meter. A 0-30 ampere DC ammeter monitors the load output current of metered units.

Fuses. Fuse F1, located on the rear deck, is a 1 1/4-ampere 3AG "SLO-BLO" fuse which functions in the internal DC auxiliary circuit.

Input Circuit Breaker. Circuit breaker CB1, located on the rear deck, is a 30-ampere, manually-reset thermally-actuated breaker which functions in the AC input circuit. When AC line current of the supply exceeds maximum safe limits, the breaker opens and input power is removed. When cause(s) for excessive current have been eliminated, depress the manual reset button to restore operation.

Connection Terminals. Make all connections to the supply at the terminal block on the rear deck. On FM suffixed models DC output connections can also be made via three five-way binding posts located on the front panel. Apply input power through the line cord or directly to terminals 1 and 2 if the line cord is removed. Always connect the ungrounded (hot) power lead to terminal 1.

The supply negative terminal is brought out to terminal 6. Recommended wiring of the power supply to the load and selection of wiring is shown in figures 1 through 11. Selection of proper wiring is made on the basis of load requirements. Make all performance checks and measurements of current or voltage at the rear output terminals. Connect measuring devices directly to terminals or use the shortest leads possible.

GROUND CONNECTIONS

The Lambda power supply can be operated either with negative or positive output terminal grounded or with no terminal grounded. Both positive and negative ground connections are shown in the diagrams for all suggested output connections illustrated in this manual.

NOTE: When operating the supply with neither terminal grounded, high impedance leakage resistance and capacitance paths can exist between the power supply circuitry and chassis ground.

BASIC MODES OF OPERATION

This power supply is designed to operate as a constant voltage source or as a constant current source. Automatic crossover to either mode of operation occurs when load conditions change as follows:

Constant Voltage. The power supply will function as a constant voltage source while the load current does not equal the current value, I_{LIM}, set by the CURRENT CONTROL-CURRENT LIMIT control. When load current $I_L = \frac{V + \Delta V}{R_L} = I_{LIM}$, the supply will cross over automatically and will operate as a constant current source. Further decrease in value of R_L results in decrease of voltage across the load while current remains limited at I_{LIM}.

Constant Current. The power supply will function as a constant current source while the load voltage V_L does not equal the voltage value set by VOLTAGE CONTROLS V and ΔV. When load voltage $V_L = V + \Delta V$, the supply will automatically cross over and operate as a constant voltage source.

SUPPLY LOAD CONNECTIONS

SAFETY NOTICE

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT. OBSERVE THE USUAL SAFETY PRECAUTIONS WHEN OPERATING OR SERVICING THE EQUIPMENT TO AVOID SHOCK OR INJURY.

Connections for Operation as a Constant Voltage Source

The output impedance, regulation and transient response of the power supply at the load are changed when using the supply as a constant voltage source and connecting leads of practical length are used. To minimize the effect of the output leads on these characteristics, remote sensing is used. Recommended types of supply load connections with local or remote sensing are described in the following paragraphs.

Refer to figures 1 and 2 to determine voltage drop for particular cable length, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 3.

Two-Wire Connection, Figure 4. The two-wire connection, with local sensing, is the connection suitable for application with relatively constant load where extremely close load regulation and fast transient response over full-rated current excursion are not required at the load.

Improved Two-Wire Connection, Figure 5. The improved two-wire connection, with local sensing, is suitable for applications where excessively long connecting leads are not used. Using multiple paralleled leads in this type of connection reduces the supply-load lead voltage drop and permits improved regulation and transient response.

Four-Wire Connection, Figure 6. The four-wire connection with remote sensing, provides effective compensation for the DC voltage drops in the connecting cables. Compensation for load drop is also valid for gradual changes of load current.

Programmed Voltage Connections, Figures 7 and 8. Discrete voltage steps can be programmed with a resistance voltage divider valued at 50 ohms/volt output and a shorting-type switch as shown in figure 7. When continuous voltage variations are required, use a variable resistor with the same 50 ohms/volt ratio in place of the resistive voltage divider and a shorting-type switch. Use a low temperature coefficient resistor to assure most stable operation.

As shown in figures 7 and 8, voltages can be programmed utilizing either local or remote sensing connections, as desired. In addition, figures 10 and 11 illustrate how the Lambda power supply can be connected to provide programmed voltage with local or remote sensing, together with programmed current.

Connections for Operation as a Constant Current Source

Figure 4 shows the connections which are used when operating the power supply as a constant current source with local setting of current control.

Programmed Current Connections, figure 9. To provide discrete current steps from 10% to 110% of rated current, use any combination of separate 4-watt resistors totaling 500 ohms together with a shorting-type switch connected as shown in figure 9. Use resistors with low temperature coefficients to assure most stable operation.

When continuous current variations are required, use a 500 ohm 4-watt variable resistor in place of the separate resistors and shorting-type switch.

As shown in figures 10 and 11, Lambda power supplies can be connected to provide programmed current together with programmed voltage.

OPERATING PROCEDURES

CAUTION

For all FM model power supplies, when performing steps of operating procedure that require adjusting the VOLTAGE CONTROLS V and ΔV knobs and the CURRENT CONTROL-CURRENT LIMITER knob, only adjust the front-panel mounted voltage and current controls. Rear-deck mounted controls for all FM models must remain locked in the full CCW position and must never be disturbed.

SAFETY NOTICE

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Constant Voltage Operation, Adjustable Current Limit

1. Remove AC power input to the supply and place POWER ON switch in down position before connecting load to the supply.

2. Determine load requirements, select wire size from figures 1-3 and choose correct type of supply-load connections from figures 4-6.

3. Connect supply to load as shown on the selected connection diagram.

NOTE: When shipped from the factory, the supply is ready for use as a constant current source or as a local-sensing constant voltage source. Jumpers are connected at the factory as shown in figure 4. Take care to remove the appropriate jumpers for load requirements that need different supply-load connections. Refer to the appropriate connection diagram.

4. Turn VOLTAGE CONTROLS V and △V knobs to the desired voltage setting. See CAUTION on page 7.

5. When current to the load must be limited to an intermediate value within the current limit rating of the supply, turn the CURRENT CONTROL-CURRENT LIMITER control to the desired current limit setting. If no intermediate current limit is required, turn the control to the full CW position to obtain current limit at maximum current limit rating of the supply. See CAUTION on page 7.

6. Apply AC power to the supply. Place INPUT FREQ SWITCH in appropriate position and lock in position.

7. Place INDICATOR SELECTOR switch in VOLTAGE REGULATED position.

8. Place POWER ON switch in up position and check that green POWER ON indicator is lit, and that red LOAD FAULT ON indicator is not lit.

9. Check that OUTPUT CURRENT and OUTPUT VOLTAGE meters indicate desired values; as required, adjust VOLTAGE CONTROLS V and △V and CURRENT LIMITER control to obtain correct meter indications. For non-metered models use externally connected meters and check that correct meter indications exist at output terminals 4 and 6.

10. Check that red THERMAL OVERLOAD indicator is not lit. Power supply is now in proper operation.

Programmed Constant Voltage Operation, Adjustable Current Limit

1. Remove AC power input to the supply and place POWER ON switch in down position before connecting load to the supply.

2. Determine load requirements, select wire size and length from figures 1, 2 and 3 and choose correct type of supply-load connection from figures 7 and 8 or 10 and 11. Refer to paragraph on Programmed Voltage Connections.

3. Connect supply to load as shown on the selected connection diagram. Take care to use a shorting-type switch for the external programming control when several voltages are desired.

4. Turn VOLTAGE CONTROLS V and △V knobs to the extreme CCW position. Adjust external programmed voltage control to desired voltage setting. See CAUTION on page 7.

5. When current to the load must be limited to an intermediate value within the current limit rating of the supply, turn the CURRENT CONTROL-CURRENT LIMITER knob to the desired current limit setting. If no intermediate current limit is desired, turn the control to the full CW position to obtain current limit at the maximum current limit rating of the supply. See CAUTION on page 7.

6. Apply AC power to the supply. Place INPUT FREQ SWITCH in appropriate position and lock in position.

7. Place INDICATOR SELECTOR switch in VOLTAGE REGULATED position.

8. Place POWER ON switch in up position and check that green POWER ON indicator is lit and that red LOAD FAULT ON indicator is not lit.

9. Check that OUTPUT CURRENT and OUTPUT VOLTAGE meters indicate desired values; as required, adjust CURRENT LIMITER knob and external programmed voltage control to obtain correct meter indications. For non-metered models use externally connected meters and check that correct meter indications exist at output terminals 4 and 6.

10. Check that red THERMAL OVERLOAD indicator is not lit. Power supply is now operating properly.

Constant Current Operation, Adjustable Voltage Limit

1. Remove AC power input to the supply and place POWER ON switch in down position before connecting load to the supply.

2. Determine load requirements and connect load to the supply as shown in figure 4.

3. Turn the CURRENT CONTROL-CURRENT LIMITER knob to the desired current setting. See CAUTION on page 7.

4. When load voltage must be limited to an intermediate value within the voltage rating of the supply, turn VOLTAGE CONTROLS V and ΔV to the desired voltage limit setting. If no intermediate voltage limit, within rating of the supply is desired, turn V and ΔV controls to the full CW position to obtain voltage limit at maximum voltage rating of the supply. See CAUTION on page 7.

5. Apply AC power to the supply. Place INPUT FREQ SWITCH in appropriate position and lock in position.

6. Place INDICATOR SELECTOR switch in CURRENT REGULATED position.

7. Place POWER ON switch in up position and check that green POWER ON indicator is lit and that red LOAD FAULT ON indicator is not lit.

8. Check that OUTPUT CURRENT and OUTPUT VOLTAGE meters indicate desired values; adjust V and ΔV voltage controls and CURRENT LIMITER control as required to obtain correct indications. For non-metered models use externally connected meters and check that correct meter indications exist at output terminals 4 and 6.

9. Check that red THERMAL OVERLOAD indicator is not lit. Power supply is now in proper operation.

1. Remove AC power input to the supply and place POWER ON switch in off (down) position before connecting load to the supply.

2. Determine load requirements and choose correct type of supply-load connection from figures 9, 10 and 11. Refer to paragraph on Programmed Current Connections.

3. Connect supply to load as shown on the selected connection diagram.

4. Turn the CURRENT CONTROL-CURRENT LIMITER knob to the extreme CCW position. Adjust external programmed current control to desired current setting. See CAUTION on page 7.

5. When load voltage must be limited to an intermediate value within the voltage rating of the supply, turn VOLTAGE CONTROL V and △V to the desired limit setting. If an intermediate voltage limit, within rating of the supply, is desired turn the V and △V controls to the full CW position to obtain voltage limit at maximum voltage rating of the supply. See CAUTION on page 7.

6. Apply AC power to the supply. Place INPUT FREQ SWITCH in appropriate position and lock in position.

7. Place INDICATOR SELECTOR switch in CURRENT REGULATED position.

8. Place POWER ON switch in ON (up) position and check that green POWER ON indicator is lit and that red LOAD FAULT ON indicator is not lit.

9. Check that OUTPUT CURRENT and OUTPUT VOLTAGE meters indicate desired values; as required, adjust external programmed current control and V and △V voltage controls to obtain correct indications. For non-metered models use externally connected meters and check that correct meter indications exist at output terminals 4 and 6.

10. Check that red THERMAL OVERLOAD indicator is not lit. Power supply is now in proper operation.

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Thermostat Shutdown

The thermostat opens the input circuit only when the temperature of the rear deck exceeds a maximum safe value. Place the POWER ON switch in the off (down) position to reset the thermostat. After eliminating the cause(s) for overheating and allowing time for the power supply to cool to a proper temperature, resume operation of the supply. Refer to appropriate paragraph in OPERATING PROCEDURES.

Fuse Shutdown

Internal component failure is prevented by fuses which protect the components from damage caused by excessive currents. Fuses will blow when the maximum rated current value for the fuse is exceeded. Fatigue failure of fuses can occur when mechanical vibrations from the installation combine with thermally induced stresses to weaken the fuse metal. Many fuse failures are caused by a temporary condition, and replacing the blown fuse will make the fuse protected circuit operative.

SERIES OPERATION

For series operation, a maximum of 200 volts can be connected between either the +DC or -DC terminal and chassis ground. When operating two (2) or more power supplies, of equal or unequal rating, in series, clamping diodes of suitable rating must be used across each of the power supplies to prevent reverse voltage from appearing across any of the individual supplies. This reverse voltage can appear under certain operating conditions and cause damage to the electrolytic output capacitors. Contact the nearest office of the Lambda Electronics Corp. for recommended diode rating suitable for specific series operation.

ADJUSTMENT OF CALIBRATION CONTROLS

Adjust Calibration Control R4 as Follows:

1. Operate the power supply for constant voltage, with local-sensing jumpers connected as shown in figure 4, and no external load.

2. Turn VOLTAGE CONTROLS V (R2) to 35-volt position and ΔV (R1) to 1-volt position.

3. Adjust R4 for 36 volts DC output, using a DC voltmeter of one percent accuracy or better. Turn the shaft firmly to break the glyptal thread-seal.

4. Apply several drops of glyptal to the threads of the potentiometer shaft to lock the shaft in position after adjustment is completed.

Adjust Calibration Control R16 as Follows:

1. Operate the power supply for constant current, with short circuit across output terminals.

2. Turn CURRENT CONTROL-CURRENT LIMITER control (R14) CW to the 25 ampere position.

3. Adjust R16 for 25 amperes DC output, using any DC ammeter of one percent accuracy or better. Turn the shaft firmly to break the glyptal thread-seal.

4. Apply several drops of glyptal to the threads of the potentiometer shaft to lock the shaft in position after adjustment is completed.

Adjust Calibration Control R49 as Follows:

1. Operate the power supply under the following conditions:

   a. Input: 135 volts at 60 cps.
   b. Mode: Constant voltage at full load, with local sensing. (see figure 4.)
   c. Output: 36 volts DC at 25 amperes.
   d. Temperature: 25°C ambient, approximately. Use a fan to apply forced air cooling to the coarse regulator (Q13 component board)

2. Using a DC VTVM, John Fluke Model 801H or equivalent, connect VTVM across collector and emitter of transistor Q19.

3. Adjust calibration control R49 until voltmeter indicates 5.85 volts. Turn the shaft firmly to break the glyptal thread-seal.

4. Apply several drops of glyptal to the threads of the potentiometer shaft to lock the shaft in position, after adjustment is completed.

PERFORMANCE CHECKS

Checks With Constant Voltage Operation

Check the ripple or regulation of the power supply using the test connection diagram shown in figure 13. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter, DC VTVM (John Fluke Model 801H or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the load to the no-load condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a Variac to vary the line voltage from 105-135 or 135-105 volts AC and check the power supply line regulation accuracy on the VTVM differential meter.

Use a VTVM, Ballantine 320 or equivalent, to measure rms ripple voltage of the power supply DC output.

Checks With Constant Current Operation

Check the ripple or regulation of the power supply using the test connection diagram shown in figure 13. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards

Check the power supply load regulation accuracy while switching from the short circuit to load condition. Measure the voltage across sensing resistor Rs. Use John Fluke Model 801H or equivalent for the VTVM connected across Rs. For Rs, use a 0.037 ohm, 64-watt resistor. To obtain regulation figure, substitute values obtained into regulation formula:

$$\frac{\Delta E}{Rs} = \text{Regulation in milliamperes,}$$

where ΔE is the voltage change in millivolts and Rs is the resistance of the sensing resistor.

Use a Variac to vary the line voltage from 105-135 or 135-105 volts AC and check the power supply line regulation accuracy using VTVM and the regulation formula $\frac{\Delta E}{Rs}$.

To measure rms ripple current of the power supply DC output, use a Ballantine Model 320 or equivalent meter and obtain ripple current I_r by substituting measured values into formula:

$$\frac{\text{V A.C. rms}}{Rs} = I_r$$

SERVICE

[illegible] additional instructions are required or repair service is desired, contact the nearest office of the Lambda Corporation where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. The receipt of this information, Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and be submitted forwarded for approval before work is started.

[illegible]

Standard components and special components used in the Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.

2. Lambda part number.

3. Description of part together with circuit designation.

4. If part is not an electronic part, or is not listed, provide a description, function, and location of the parts.

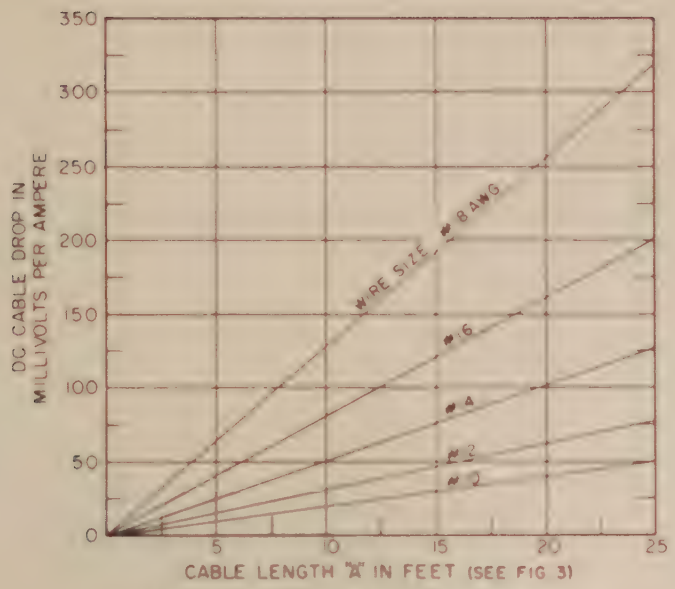


FIG.1. 2-WIRE CONNECTION (SEE FIG 4)

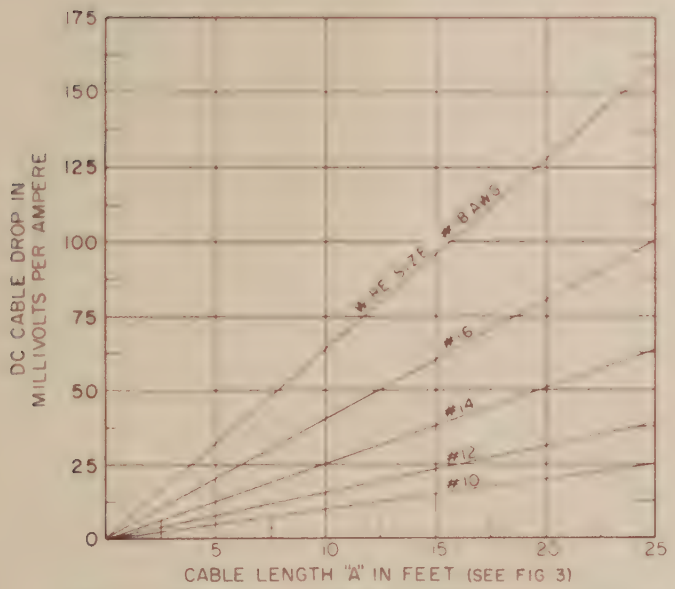


FIG. 2. IMPROVED 2-WIRE CONNECTION (SEE FIG.5)

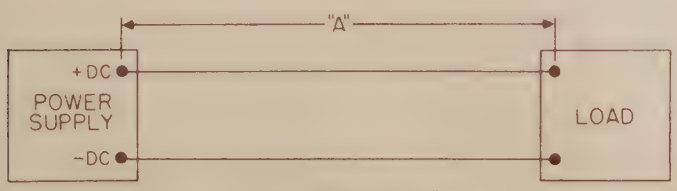
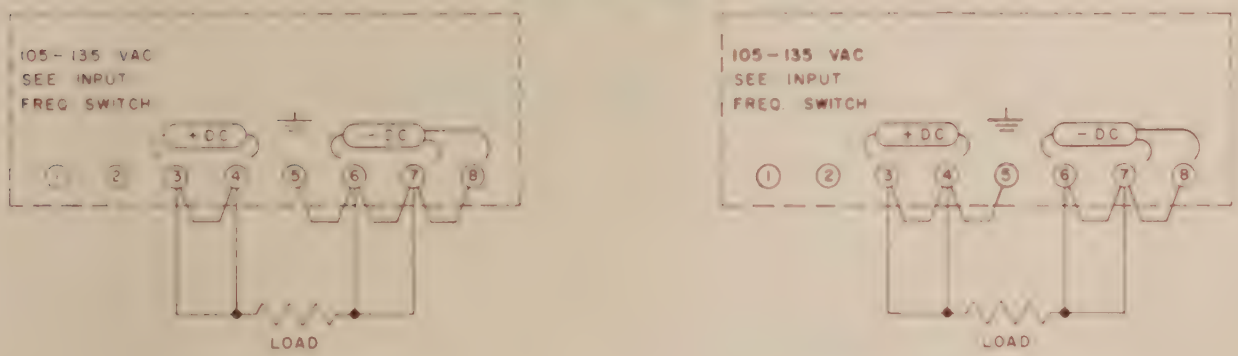


FIG. 3. CABLE LENGTH "A" IN FEET

(a) NEGATIVE TERMINAL GROUNDED

(b) POSITIVE TERMINAL GROUNDED

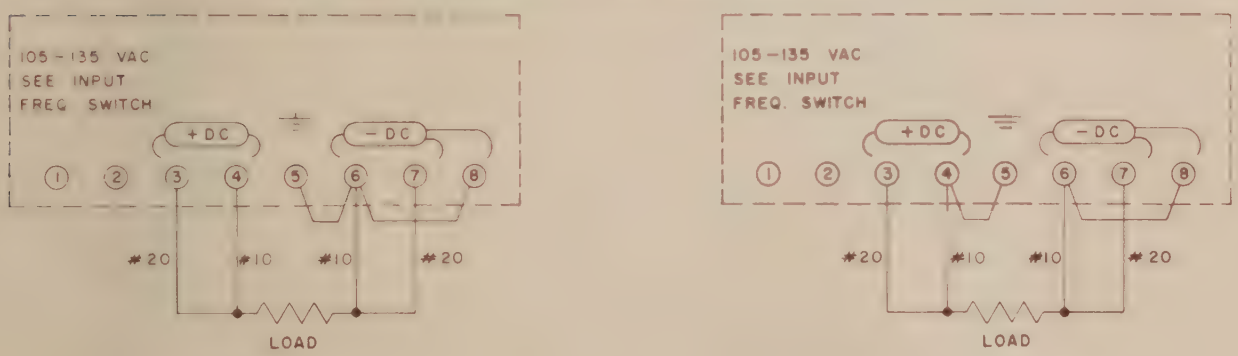
FIG. 4. TWO – WIRE CONNECTION



(a) NEGATIVE TERMINAL GROUNDED

(b) POSITIVE TERMINAL GROUNDED

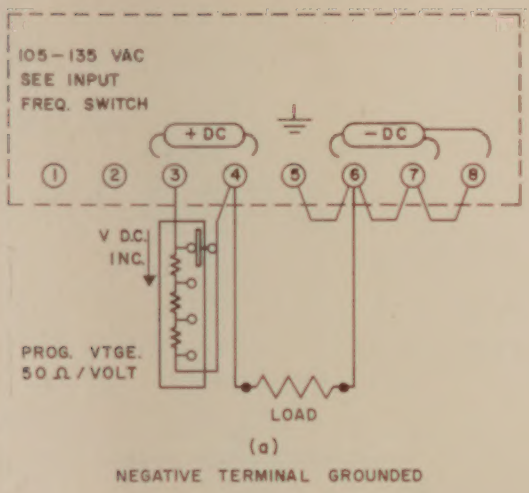
FIG. 5. IMPROVED TWO – WIRE CONNECTION



(a) NEGATIVE TERMINAL GROUNDED

(b) POSITIVE TERMINAL GROUNDED

FIG. 6. FOUR – WIRE CONNECTION



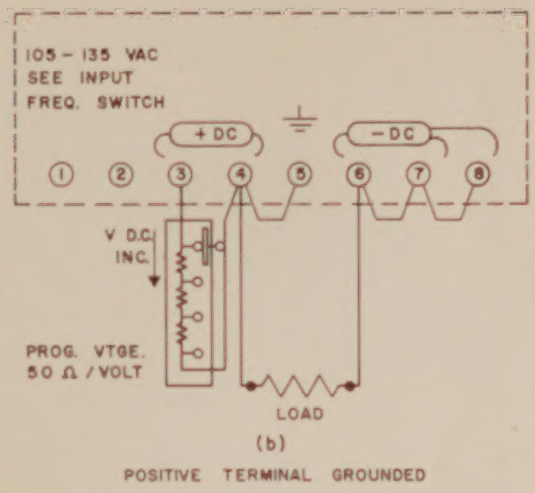
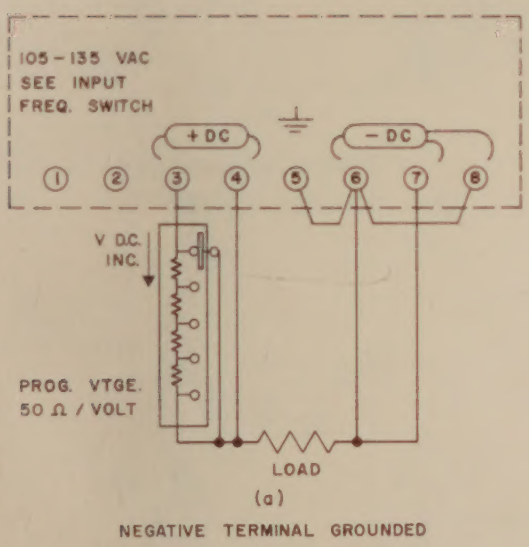


FIG. 7. PROGRAMMED VOLTAGE, LOCAL SENSING



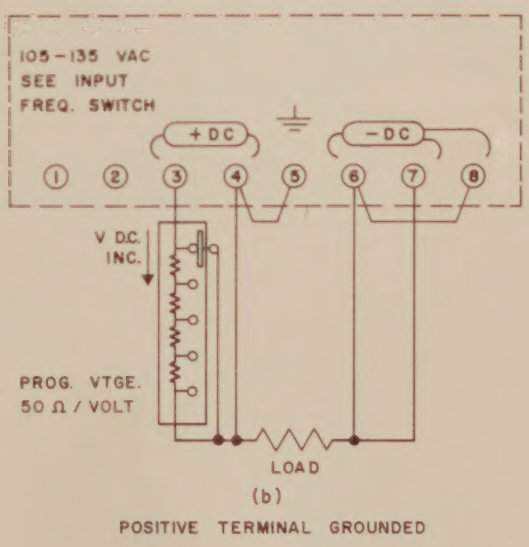


FIG. 8. PROGRAMMED VOLTAGE, REMOTE SENSING

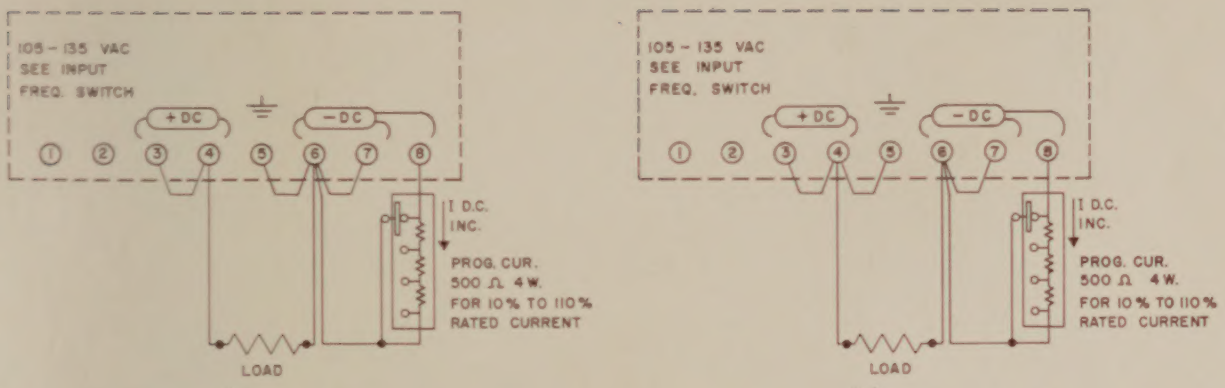


FIG. 9. PROGRAMMED CURRENT

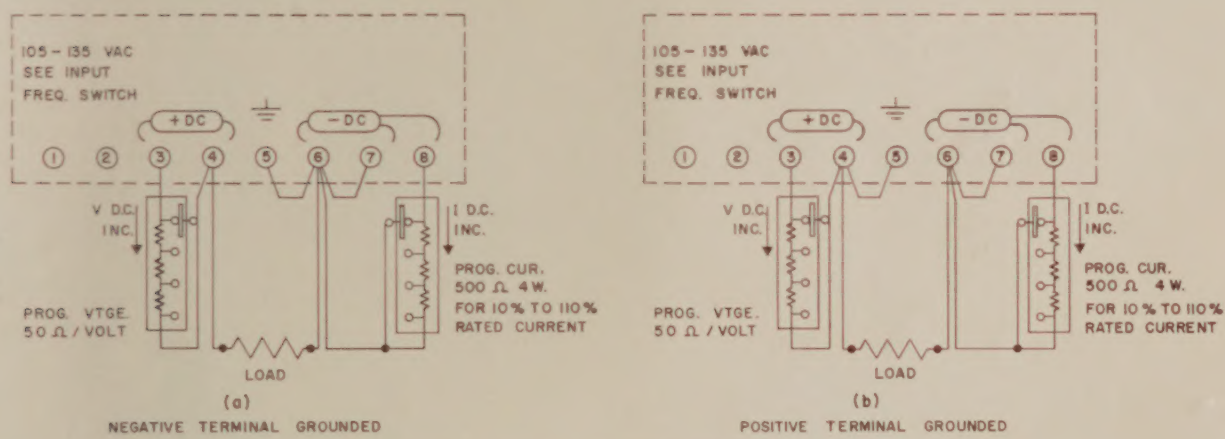


FIG. 10. PROGRAMMED VOLTAGE, LOCAL SENSING & PROGRAMMED CURRENT

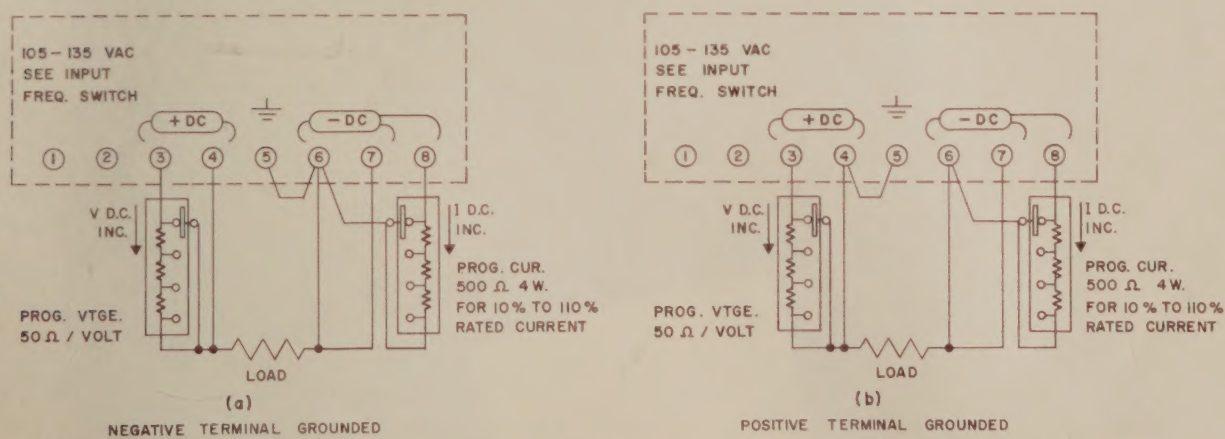


FIG. 11. PROGRAMMED VOLTAGE, REMOTE SENSING & PROGRAMMED CURRENT

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